

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

What is claimed is:

1. (Currently Amended) ~~In a~~ A vertical cavity surface emitting laser (VCSEL), comprising:

vertically stacked material layers including a first material layer positioned above a second material layer; ;

an intermediate region being disposed therebetween, electrical current flowing between the first material layer and the second material layer through the intermediate region during operation of the VCSEL; ; and

a current confinement structure for laterally restricting the flow of electrical current passing through the intermediate region, comprising:

a central column of semiconductor material vertically extending between the first and second material layers;

a subsurface cavity laterally circumscribing said central column of semiconductor material and vertically extending between the first and second material layers, said subsurface cavity being filled with a non-solid material or vacuum; and

an outer support element laterally surrounding said subsurface cavity, said outer support element comprising a non-electrically-conducting material, said outer support element mechanically supporting said first and second material layers in conjunction with said central column of semiconductor material, the electrical current being laterally

confined to said central column while passing from the first layer to the second layer.

2. (Original) The current confinement structure of claim 1, the VCSEL having a plurality of upper material layers positioned above said first material layer, further comprising at least three vertically etched shafts extending downward from a top surface of said upper material layers to said subsurface cavity.
3. (Original) The current confinement structure of claim 2, wherein said vertically etched shafts are plugged such that said subsurface cavity is sealed.
4. (Currently Amended) The current confinement structure of claim 3, wherein said non-solid material is air ~~or vacuum~~.
5. (Original) The current confinement structure of claim 3, wherein said non-solid material comprises an inert gas.
6. (Original) The current confinement structure of claim 3, wherein said vertically etched shafts are plugged with a polyamide sealer.
7. (Currently Amended) The current confinement structure of claim 2 [[1]], said outer support element and said central column being formed from a common layer of semiconductor material, said outer support element being implanted so as to be non-electrically-conductive.
8. (Original) The current confinement structure of claim 7, said first material layer and said upper material layers being implanted in lateral regions thereof lying above said outer support element.

9. (Original) The current confinement structure of claim 8, the VCSEL having a plurality of lower material layers positioned below the second material layer, said second material layer being an active layer, wherein electrical current flowing through the second material layer to the lower material layers is substantially confined to a lateral area corresponding to a lateral extent of said central column of semiconductor material.

10. (Original) The current confinement structure of claim 8, said first material layer being an active layer, wherein electrical current flowing through the first material layer to the second material layers is substantially confined to a lateral area corresponding to a lateral extent of said central column.

11. (Original) The current confinement structure of claim 8, wherein said common layer of semiconductor material forming said central column and said outer support element comprises an oxidation-resistant, low-bandgap semiconductor material.

12. (Original) The current confinement structure of claim 11, said common layer of semiconductor material being InGaAs or InGaAsP.

13. (Original) The current confinement structure of claim 12, the VCSEL having a plurality of lower material layers positioned below the second material layer, said second material layer being an active layer, wherein said upper material layers comprise a distributed Bragg reflector (DBR), wherein said first material layer is a p-doped semiconductor layer, and wherein said lower material layers comprise a DBR.

14. (Original) A vertical cavity surface emitting laser (VCSEL) formed from a vertical stack of substantially flat material layers, comprising:
an active layer disposed between a first set of material layers thereabove and a second set of material layers therebelow, electrical current flowing between said first set and said second set of material layers during operation of the VCSEL; and

a current confinement layer positioned substantially adjacent to said active layer, said current confinement layer being partitioned into a central current confinement zone comprising a semiconductor material and an outer support zone comprising an implanted semiconductor material, said central current confinement zone being separated from said outer support zone by a subsurface cavity laterally circumscribing said central current confinement zone, the electrical current flowing through said active layer only in a laterally extending area substantially corresponding to said current confinement zone of said current confinement layer.

15. (Original) The VCSEL of claim 14, at least three vertically etched shafts extending downward from a top surface of said first set of material layers to said subsurface cavity, wherein each of said first set of material layers remains laterally integral over said central current confinement zone, said subsurface cavity, and said outer support zone at locations other than said vertically etched shafts.

16. (Original) The VCSEL of claim 15, wherein said vertically etched shafts are plugged such that said subsurface cavity is sealed.

17. (Original) The VCSEL of claim 16, wherein said subsurface cavity is filled with air, vacuum, or an inert gas.

18. (Original) The VCSEL of claim 16, wherein said vertically etched shafts are plugged with a polyamide sealer.

19. (Original) The VCSEL of claim 14, wherein said semiconductor material of said current confinement layer is oxidation-resistant.

20. (Original) The VCSEL of claim 19, wherein said semiconductor material of said current confinement layer is a low-bandgap semiconductor material.

21. (Original) The VCSEL of claim 20, wherein said semiconductor material of said current confinement layer is InGaAs or InGaAsP.